Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	90.603	93.222	85.122						Continuing	Continuing
621123: Learning and Organizational Collaboration	17.972	18.349	13.537						Continuing	Continuing
625328: Human Dynamics Evaluation	0.000	0.000	18.280						Continuing	Continuing
625329: Sensory Evaluation and Decision Science	0.000	0.000	21.202						Continuing	Continuing
627184: Performance Evaluation in Extreme Environments	44.504	55.935	16.964						Continuing	Continuing
627757: Directed Energy Bioeffects	28.127	18.938	15.139						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329, and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This program conducts applied research on Airmen training, Airmen system interfaces, directed energy bioeffects, deployment and sustainment of Airmen in extreme environments, and understanding and shaping adversarial behavior. The Learning and Organizational Collaboration project conducts research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. The Human Dynamics Evaluation project conducts research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. The Sensory Evaluation and Decision Science project conducts research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. The Performance Evaluation in Extreme Environments project conducts research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The Directed Energy Bioeffects project conducts research on the effects of human exposure to electromagnetic energy (radio frequency

Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification	DATE: May 2009
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to optical), scalable directed energy weapons, and non-lethal weapons. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	92.068	82.091	92.603	
Current BES/President's Budget	90.603	93.222	85.122	
Total Adjustments	-1.465	11.131	0.000	
Congressional Program Reductions	0.000	-0.016		
Congressional Rescissions	0.000	-0.253		
Total Congressional Increases	0.000	13.800		
Total Reprogrammings	-0.275	-2.400		
SBIR/STTR Transfer	-1.190	0.000		

Change Summary Explanation

In FY 2009, Congress added $3.0 million for Homeland Emergency Learning and Preparedness (HELP) Center, $2.0 million for Imaging Tools for Human Performance Enhancement and Diagnostics, $0.8 million for Smart View Program (SVP), $0.8 million for Tools and Technologies for Incident and Consequence Management, $1.6 million for Component Object Model Attitude Control System Simulation/Trainer, and $3.2 million for Ultra High Resolution Deployable Projector for Simulation.

C. Performance Metrics

Under Development.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 621123	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
621123: Learning and Organizational Collaboration	17.972	18.349	13.537						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts applied research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. Research is conducted in three focus areas: immersive environments; continuous learning and aiding; and cognitive and behavioral modeling. The immersive environments effort creates live, virtual, and constructive (LVC) decision-making environments for use in developing revolutionary simulation technologies to increase training capabilities. Continuous learning and aiding enhances training effectiveness and efficiency by using learning theory to improve military training and mission performance. Cognitive and behavioral modeling creates realistic models and simulations of human behavior to advance the understanding of how people perform complex tasks.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The immersive environments focus area will research methods to enhance Distributed Mission Operations (DMO) and decision dominance environments. Identify the visual requirements necessary for realistic aircrew training and mission rehearsal, allowing AF warfighters to train as they intend to fight. Create the capability for seamless, high-fidelity, fully-immersive participation in LVC environments to include air, cyber, and space domains. Provides warfighters with validated approaches to experience, train, and rehearse in immersive environments with weather, weapons, combat, visual, and sensory effects. Note: The increase in funding in FY 2010 is due to increased emphasis in this area. In FY 2008: Researched perceptual issues for out-the-window display and targeting pod simulation systems that will allow for greater realistic composite force training. Explored perceptual characteristics for new deployable visual display technologies. Expanded human factors visual research to define display requirements for a fully immersive collaborative environment for DMO. In FY 2009: Perform human factors analysis, tests, and evaluations of visual and sensor simulation components for air-to-ground and air-to-air composite force training using air-to-surface operational testbed. Conduct perceptual evaluations of compact immersive display concepts and components. Transition results to	1.893	1.814	4.282	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
address broader range of AF mission areas and initiate research on sensory-driven decision making in complex environments. In FY 2010: Research training and rehearsal issues for helmet cueing and targeting pod simulation systems that will allow for greater realistic composite force training. Expand sensory-driven modeling efforts to predict targeting pod performance and investigate how neural-sensory measurements correlate with model predictions. Define sensory requirements for a fully immersive collaborative training environment for DMO. Assess modeling and simulation requirements for intelligent threat models to support immersive training. Conduct research for the capabilities needed for a full-threat reaction trainer system. Enhance training capabilities by populating DMO databases with robust 3-D cultural content and correlated sensor attribution.					
MAJOR THRUST: The continuous learning and aiding focus area will research and analyze tools, strategies, and performance support methods for improving personnel selection, Airmen combat mission training, rehearsal, and operations, including command and control, intelligence, surveillance, and reconnaissance (ISR), unmanned aerial system (UAS) and cyber missions. Apply empirical data to develop guidelines for improving learning and decision making in training and rehearsal for combat air forces and global strike operations. Enhance the quality, management, and effectiveness of DMO LVC training, rehearsal, and exercise environments through competency-based training methods. Note: The decrease in funding in FY 2010 is due to decreased emphasis in this area. In FY 2008: Evaluated approaches and tools for integrating principles of learning in LVC environments. Identified methods and tools to manage learning in operational training contexts. Identified and analyzed methods of routinely assessing knowledge and skills for combat readiness. Analyzed field data to identify opportunities for competency-based training integration. Analyzed how to monitor the integration of distributed training and rehearsal into operational readiness contexts. Evaluated common measurement tools for assessing readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and exercise events. Explored scenario sequencing methods for continuous learning. Conducted in-depth analysis of the training related shortfalls of current DMO computer generated forces. Explored hardware and software solutions allowing functional processing of selected friendly/enemy interactions for extremely high fidelity training.		8.486	8.168	5.719	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Researched and analyzed parameters for a network server for high-fidelity weapons models which allows real- or near-real-time processing of DMO interactions for more accurate weapons effects and engagements. In FY 2009: Develop tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identify alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrated instructional development and management methods for continuous learning in LVC contexts and explore task allocation methods for performance aiding and training in operational contexts. Identify functional requirements for instructor operator station capabilities. Investigate and evaluate physics-based directed energy threat models for DMO systems. Define improved rule sets to enhance training utility of computer-generated forces. Assess feasibility of enhanced threat avoidance and rehearsal training combining selected aerodynamic models, directed energy models, and validated visual special effects. In FY 2010: Develop methods for identifying common knowledge, skill, and experience requirements for individuals, teams, and teams-of-teams in manned and unmanned aerospace environments. Develop methods for adapting learning and performance environments to support individual and team training within and across AF and coalition mission areas. Develop tools for routinely tracking and storing experience and performance based on operational activities and training events. Explore methods that permit persistent learning within and across aerospace operational training, rehearsal, exercise, test, and evaluation contexts. Evaluate alternative approaches for training in LVC environments and across tactical, operational, and strategic levels of decision making.					
MAJOR THRUST: The cognitive and behavioral modeling focus area will explore the application of cognitive science for performance improvement by enhancing training in AF mission-relevant environments, including flight simulators and air and space operations centers. Develop computational and mathematical models of human performance and learning as enabling technologies for improving readiness across an assortment of AF career fields, from combat air forces to command and control personnel.		3.669	3.580	3.536	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Expanded the depth of the communication models to support the full range of vocabulary and grammar used in the air and space operations center training environment. Conducted empirical study with skill acquisition/retention models. Extended automation functionality to include dynamic model validity and refinement capability. In FY 2009: Expand the breadth of the communication model to support end-to-end language processing. Integrate knowledge and skill tracking prediction system with mission essential competencies to predict training requirements for Airmen and demonstrate the ability to produce individualized training programs. Conduct empirical study with skill acquisition/retention models. Validate semi-automated, adaptive parameter search and model optimization capability and implement graphical user interface for performance moderator prediction system. In FY 2010: Create adaptive language comprehension and generation capability for computer-generated communication models. Continue to integrate knowledge and skill tracking prediction system with mission essential competencies to predict individualized, optimized training requirements for Airmen. Broaden ability to model and predict individual differences in trainee susceptibility to cognitive fatigue across multiple tasks.				
CONGRESSIONAL ADD: Component Object Model (COM) Attitude Control System Simulation/Trainer. In FY 2008: Conducted Congressionally-directed effort for COM Attitude Control System Simulation/Trainer. In FY 2009: Conduct Congressionally-directed effort for COM Attitude Control System Simulation/Trainer. In FY 2010: Not Applicable.	3.924	1.596	0.000	
CONGRESSIONAL ADD: Ultra High Resolution Deployable Projector for Simulation. In FY 2008: Not Applicable.	0.000	3.191	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009: Conduct Congressionally-directed effort for Ultra High Resolution Deployable Projector for Simulation. In FY 2010: Not Applicable.				

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602233N/ Human Systems Technology.	0.000	0.000							Continuing	Continuing
PE 0602716A/ Human Factors Engineering Technology.	0.000	0.000							Continuing	Continuing
PE 0602785A/ Personnel Performance and Training Technologies.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604227F/ Distributed Mission Training (DMT).	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 625328	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625328: Human Dynamics Evaluation	0.000	0.000	18.280						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. Research will be in six focus areas: mission-essential human capabilities for air, space, and cyber operations; enhancing human components of intelligence, surveillance, and reconnaissance (ISR); anticipatory command, control, and intelligence (C2I); adversarial modeling and cross-cultural communication; predicting and evaluating organizational effectiveness alignment and collaboration readiness; and electromagnetic theory. These focus areas will enhance capabilities in layered sensing, decision aids for computer network attack/defense/survive, and human-centric exploitation of measurement and signatures intelligence.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Conduct applied research to identify methods to enhance mission-essential human capabilities for cyber operations. Develop analytical models demonstrating human-optimization concepts for cyber operators in the operations support center environments. Analyze human-centric techniques and models that increase cyber operator situational awareness. Develop measures of effectiveness for cyber capabilities. Define scientific architecture to enhance cognitive cyber performance. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to enhance performance and increase situational awareness within cyber operations, including operations support center environments. Develop the operator's ability to anticipate and influence the behavior of adversaries. Conduct foundational studies toward enhancing cognitive cyber performance.	0.000	0.000	6.130	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Conduct applied research to enhance human components of ISR. Research human-centered design processes and operational tools that will increase productivity while decreasing cycle times. Develop ability to anticipate, influence, and dominate an adversary's air, space, and cyber ISR systems, processes, and organizations. Develop quantifiable measures of effectiveness to analyze and select advanced ISR mission planning, analysis, and assessment techniques. Analyze means of optimizing information flows among decision makers operating in net-centric, measurement and signatures intelligence (MASINT) environments. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct cognitive task analysis and cognitive systems engineering to develop new intelligence analyst tools, training, and methods to establish and demonstrate dynamic command and control of air, space, and cyber ISR collection capabilities. Specific ISR capability objectives include universal situational awareness, dynamic control of ISR planning, workload reduction, and multi-source/multi-intelligence collaboration.		0.000	0.000	1.600	
MAJOR THRUST: Conduct applied research to develop technology base for an anticipatory C2I decision support environment that uses past and present battlefield mission states to predict adversarial intent and actions. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	2.250	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 625328	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Refine knowledge of representation techniques to model potential adversarial behavior and complex systems of systems and begin integrating information within visual displays. Research integrated set of work aids to achieve persistent operational planning, persistent prediction, and focused execution. Develop aids to enhance understanding of underlying C2I models and algorithms.					
MAJOR THRUST: Conduct applied research in adversarial modeling and cross-cultural communication. Concentrate on modeling techniques to gauge adversarial intent and probabilities/methods of attack. Develop models demonstrating quantitative measures of effectiveness of advanced influence operations capabilities. Research and develop automated speech translation tools for obscure languages. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to develop behavioral modeling techniques to gauge adversarial threats. Develop measures of effectiveness for selected influence operations capabilities. Develop speech-to-speech translation tools that support automated, cross-cultural communications.		0.000	0.000	6.137	
MAJOR THRUST: Develop models and metrics to predict and evaluate organizational effectiveness alignment and collaboration readiness. Develop organizational simulations and explore opportunities for organizational network analysis. Conduct organizational effectiveness research including work design, organizational assessment, and strategic transformation management. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	1.113	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Identify organizational vulnerabilities at the structure, organizational culture, process, or human operator levels. Focus on exploitation of theories involving human trust in automation and interpersonal relationships to provide an understanding of how to influence systems with little to no degree of detection/ suspicion among operators. Develop relevant organizational metrics, work design solutions, and simulation models to facilitate organizational effectiveness.				
MAJOR THRUST: Conduct applied research in the areas of mathematics and electromagnetic theory to exploit/counter adversarial capabilities. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research on datasets from past/current influence operations. Continue anticipatory research designed to enhance blue force situational awareness of adversarial location and intent.	0.000	0.000	1.050	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 625329	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625329: Sensory Evaluation and Decision Science	0.000	0.000	21.202						Continuing	Continuing

Note

Note: In FY 2010, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to revolutionize the manner in which the human optimizes the capabilities of AF systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. Research optimizes situational awareness, improves the human-machine interface, and seamlessly integrates warfighters with their weapon systems across air, space, and cyber domains. Research is conducted in four focus areas: network-centric collaboration, supervisory control, battlespace visualization, and battlespace acoustics. The network-centric collaboration area develops warfighter interface technologies to enhance human-human and human-machine collaborations and system interactions in distributed decision-making environments. The supervisory control area develops new control/display concepts and technologies to optimize AF platform capabilities. The battlespace visualization area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. The battlespace acoustics area researches human-human and human-machine communications to exploit the use of voice and acoustic data in collaborative, net-centric environments while accounting for the effects of acoustic propagation.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The network-centric collaboration area develops warfighter interface technologies to enhance human-human and human-machine collaboration and system interaction in distributed decision-making environments. These technologies will enable the common operational understanding and shared, distributed decision making required on the modern battlefield. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000	0.000	5.017	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2010: Investigate individual and teams-of-teams performance metrics for team collaboration in a cross-domain distributed environment to include air, space, and cyber. Explore alternate human sensory technologies for operator functional state model development. Begin initial understanding of adaptive interface algorithms for individual operator decision aiding.				
MAJOR THRUST: The supervisory control focus area will research new control/display concepts and technologies (e.g., information portrayal, control devices, and decision aiding algorithms) for AF platforms. Identify the best mix of intelligent methods and traditional design to unambiguously direct operator attention, critical for net-centric operations and UAS operations. Employ real-time and wargaming simulations to quantify operational benefits from new information portrayal concepts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Design and evaluate advanced visualization concepts to support rapid situation assessment associated with switching tasks, interruptions, and unexpected state changes within multi-UAS control scenarios. Evaluate novel video exploitation aids to enable a single operator to monitor multiple video feeds. Compress critical net-centric and system information onto man-portable UAS interfaces in a manner that permits flexible, high-level tasking without undue workload. Identify techniques that improve operator awareness of UAS automation mode and rationale for autonomous decisions.	0.000	0.000	5.744	
MAJOR THRUST: The battlespace visualization focus area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. Develop, evaluate, and organize image enhancement techniques for improving input to the visual system through the fusion of multi-spectral sensors to enhance real-time, day/night imaging systems. Devise human-centered command and control visualizations and interaction techniques for integration with visual displays, permitting natural situation understanding of complex information-rich environments.	0.000	0.000	5.902	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Explore vision enhancement techniques to increase rapid classification and identification for objects of interest in air, space, and cyber. Develop visualization technologies and interaction techniques for presenting complex information to enhance air, space, and cyber operations. Investigate presentation and interface technologies for enhancing space situational awareness.					
MAJOR THRUST: The battlespace acoustics focus area researches human-human communications to exploit the use of voice data in collaborative, net-centric environments. Conduct research on three-dimensional audio, active noise reduction, and related technologies that mitigate effects of noise and enhance performance and information processing in the operational environment. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information delivery to the warfighter. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Examine applications of how advanced multimodal interfaces can optimize distributed team performance in large-scale communication networks. Conduct research on network-based audio technologies for achieving shared situational awareness and exploiting information from multi-layered arrays of sensors in complex operational environments. Explore the use of persistent audio displays and other advanced auditory cueing techniques for continuously monitoring the status of complex UAS technologies. Conduct research on sensor systems and immersive display technologies for facilitating remote telepresence and optimizing the presentation of complex information in human-machine interfaces.		0.000	0.000	4.539	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research					PROJECT NUMBER 627184	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
627184: Performance Evaluation in Extreme Environments	44.504	55.935	16.964						Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329, and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The research is focused in four areas: biobehavioral performance, biomechanics, applied biotechnology, counterproliferation. Both biobehavioral and biomechanics focus areas enhance Airmen performance and survivability through dynamic human modeling techniques that define the capabilities and limits of system operators under military-unique stressors, as well as assessing and identifying adversarial threats. Applied biotechnolology advances bioscience, nanotoxicology, and neuroscience research to protect Airmen from the effects of toxic chemicals and materials, and to monitor and enhance cognitive and physiological performance. Counterproliferation research focuses on biotechnology for the detection, identification, monitoring, and neutralization of biological threat agents.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop interface technologies that enhance human-human and human-machine collaboration in network-centric warfare environments. These technologies will enable the common operational understanding and shared, distributed decision making required on the modern battlefield. Note: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. In FY 2008: Developed multinational speech translator technologies for obscure languages and continued to advance technologies that support mobile, speech-based interfaces. Completed a style guide for applying collaborative tools in air battle management command and control environments. Developed a collaboration toolkit for non-airborne command and control missions. Expanded the operator cognitive state assessor to incorporate operator performance data, operator performance and situational awareness models, and tactical situation information for better decision support.	3.958	4.997	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Explore the use of transparent multilingual collaboration tools for distributed multi-entity teaming. Continue development of multinational speech translation technologies for obscure languages. Determine the effects of collaboration technologies on performance efficiency, shared situation awareness, workload and decision making for tactical command and control. Begin development of adaptive automated human-machine interfaces to improve real-time human-machine task sharing. Develop predictive operator state models and assessment tools for dynamic workflow and workload management. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop cognitive system interface technologies to achieve common understanding at all echelons of operations and to improve decision-making and predictive battlespace awareness. These technologies offer breakthrough potential for understanding and modeling human behavior, in order to assure timely and effective decisions, while also providing context-sensitive human-computer interfaces that support decision effectiveness. Note: In FY 2010, this major thrust will move to Project 5328 to better align efforts. In FY 2008: Advanced software design patterns that enable the standardization and re-use of human-computer interface elements in command and control ISR systems. Developed a DoD software design patterns library. Developed collaboration techniques and methods to embed these techniques into command and control systems. Demonstrated collaboration techniques in a distributed net-centric environment. Researched the cultural and ethnic bases of human decision making and developed human performance models that reflect cultural differences for effects-based operations. In FY 2009: Expand contents of DoD software design patterns library. Begin embedding design patterns in graphical user interface building tools. Continue to demonstrate collaboration techniques in a distributed net-centric environment. Investigate how collaboration techniques can enable distributed team self-synchronization. Continue researching the cultural and ethnic bases of human decision making and developing human performance models that reflect cultural differences to enable effects-based operations. In FY 2010: Not Applicable.		3.552	4.385	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Establish the technology base for a decision support environment that enables the Joint Forces Commander, Joint Forces Air Component Commander, and command staffs to interrelate the past, present, and future battlefield mission states and to predict the intent and actions of adversaries during joint operations. Note: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. In FY 2008: Transitioned advanced uncertainty visualization techniques for command center displays. Transitioned to advanced development the needed methods to simulate enemy potential courses of action, including more complex adversary behavior. Evaluated results of the laboratory experiments on “sensemaking” tools and displays for dynamic battlefields. Identified gaps for further research. Incorporated the extrapolated, select “sensemaking” results into display development. Refined the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Initiated transition of integrated set of anticipatory planning and operations (APO) work aids to achieve persistent operational planning, persistent prediction, and focused execution. Conducted initial demonstration of the integration of the developed displays and technologies. In FY 2009: Analyze the results of the initial demonstration of the integration of the displays and technologies. Complete the transition of advanced uncertainty visualization techniques for command center display. Continue transition of methods needed to simulate enemy potential courses of action, including more complex adversary behavior. Incorporate more extrapolated “sensemaking” results into displays. Refine the knowledge representation techniques to model potential adversaries and complex systems of systems and begin integrating into displays. Continue transitioning the integrated set of APO work aids to achieve persistent operational planning, persistent prediction, and focused execution and evaluate the effect. Conduct follow-on demonstration of the integration of the developed displays and technologies. In FY 2010: Not Applicable.	1.822	2.237	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop system control interface concepts enabling full operator exploitation of all AF platform capabilities. Identify the best mix of intelligent methods and traditional design to unambiguously direct the operator's attention, which is critical for net-centric operations. Employ real-time and wargaming simulations to quantify operational benefits from new information portrayal concepts. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts. In FY 2008: Evaluated single operator supervision of multiple autonomous unmanned aerial vehicles (UAV) in a net-centric context using real-time assessment tools and advanced decision support interfaces during testing and simulated ground operations. Transitioned field test results of first generation control-display concepts that reduce operator task loading and channelized attention into second generation control-display workstations. Applied basic algorithms that blend display imagery with computer-generated graphical representations of terrain and real-time data during simulation and/or fight-testing of autonomous landing and ground operations. In FY 2009: Integrate real-time assessment tools into second generation control-display operator workstations to optimize operator task loading and avoid channelized attention. Use second generation operator workstations during field testing and flight demonstration to control multiple, highly autonomous UAVs. Begin software design and development of common interface and software architectures of control-display concepts that allow minimal numbers of operators to control autonomous UAVs in urban environments and/or in large-scale, strategic military operations. In FY 2010: Not Applicable.	3.675	4.514	0.000	
MAJOR THRUST: Develop technologies associated with collecting and optimizing visually displayed information for best assimilation by warfighters. Develop, evaluate, and organize algorithms for enhancing input to the visual system through the fusion of multispectral sensors, digital image processing, and solid-state display technologies in order to enhance real-time, day/night imaging systems. Devise human-centered command and control symbology and techniques for integration with visual displays, permitting natural situation understanding of complex information rich environments. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts.	3.693	4.608	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2008: Down-selected and implemented image-enhancing algorithms that are optimized for speed, visual performance, and real-time tactical use. Developed a laboratory-grade test bed usable to perform field tests. Developed and evaluated new and innovative ways to visualize and interact with large amounts of information in visually rich environments. Evaluated display symbologies and mechanizations in simulated air and space operations center environments. In FY 2009: Perform multispectral, real-time field evaluations of display algorithm sets that have been optimized for different tactical scenarios. Refine information portrayal and interaction techniques to enhance decision-making by testing more intuitive visualizations and user interfaces. Test these methods against current state-of-the-art to prove and improve total system effectiveness. Begin to develop visualization technologies that enhance cyberspace understanding in command centers. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop advanced audio display technologies for human-to-human collaboration including three-dimensional (3-D) audio, active noise reduction, and related technologies that mitigate effects of noise and enhance performance and information processing in operational environments, including the cockpit. In particular, these battlespace acoustic interfaces will integrate with warfighter equipment and amplify information delivery to the warfighter. Note: In FY 2010, this major thrust will move to Project 5329 to better align efforts. In FY 2008: Explored the potential of acoustic aiding during urban operations to improve machine-to-human communications by using acoustic signal processing to improve security forces' information gathering. Researched ways to adapt current noise models to enhance decision-making and acoustic detectability during offensive operations. Developed auditory information-aiding technologies for remote collaboration, by exploiting advances in communication theory for individuals. Explored the individual and group processes that lead to communication breakdown. Explored improved auditory sensing to create virtual auditory reality for human interface to remote sensing.		3.233	3.826	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Develop acoustic aiding for urban operations to improve machine-to-human communications by using ultrasonic and laser technology advances to improve security forces' information gathering. Continue to explore methods and develop models to predict acoustic detectability under dynamic conditions for improved offensive operations. Continue to develop auditory information-aiding technologies for remote collaboration by exploiting advances in communication theory for individuals. Continue to explore the individual and group processes that lead to communication breakdown. Improve auditory sensing technology to create virtual auditory reality for human interface to remote sensing, emphasizing its application to security forces. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop integrated human-centered Information/Cyber Operations and Intelligence, Surveillance, and Reconnaissance (ISR) technologies to provide quicker and more intuitive access to information, enhanced decision-making capabilities, more effective training procedures, and improved tools for Information Operations (IO)/ISR/Cyber operators' use in performing their respective missions. Note: In FY 2010, this major thrust will move to Project 5328 to better align efforts. In FY 2008: Validated conceptual human-system interfaces for additional MASINT capabilities. Developed and validated tools and models for assessing the effectiveness of influence operations. Researched and developed tools and capabilities for Influence Operations and counter-Influence Operations. Developed tools and models for assessing the effectiveness of influence operations. Researched and validated speech-to-speech translation tool. Developed capability to anticipate adversarial behavior, both individually and in groups. Researched counter-improvised explosive device solutions. In FY 2009: Continue development and validation of advanced IO/Influence Operations research tools and training techniques to enable increased offensive and defensive combat capabilities which counter asymmetric adversarial threats. Validate and complete IO/Influence Operations models and simulation capabilities. Develop and validate prototype of advanced speech-to-speech translation tool. Continue development of capability to anticipate adversarial behavior, both individually and in group, with application in the psychological		9.091	11.912	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
operations domain. Investigate methods to enhance human ability to uncover concealed information. Develop collaborative tools and training for ISR team applications with emphasis on distributed operations. In FY 2010: Not Applicable.				
MAJOR THRUST: Develop protective system technologies to provide sanctuary from threats to military personnel. Develop technologies to ensure accommodation and safety of all airmen during military operations, such as flight, ground patrols, crashes, emergency escape, extended missions, and parachute opening shock. Quantify culturally-relevant physical behaviors to understand human performance and threat signatures. Develop databases of human motion, actions, reactions, and features across diverse populations and environments in order to make predictions of impending physical actions, especially in regards to threat detection. In FY 2008: Conducted focused injury surveillance studies on specific career fields and assignments to identify those that have high rates of injury and disability. Based on these studies, developed technologies to reduce musculoskeletal disabilities and injuries due to personal equipment and workstation designs. Developed procedures and training improvements to reduce high training attrition due to injury, especially focused on battlefield Airmen training. Expanded initial biomechanics collaborative information system to coordinate DoD biomechanics data collections and analysis capabilities. In FY 2009: Optimize equipment technologies, refine procedures, and improve training processes to address the most common AF job-related injuries and disabilities. Extend these improvements to not only prevent injuries but also to optimize human performance. Develop workstation design criteria to maximize operator performance and minimize fatigue, based on interrelationships between equipment fit, workload, anthropometry, physical capability, and cognitive capability. Use biomechanics collaborative information technologies to collect and analyze data to protect forces against threats in hostile environments. In FY 2010: Use principles of biomechanics to analyze behavioral data. Collect motion data and develop initial analysis techniques to identify behaviors that seem out-of-context. Include cultural information to	3.534	4.698	4.503	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
develop physical behavior signatures. Integrate information from multiple sensors to help identify a human threat.					
MAJOR THRUST: Quantify and model operator performance in stressful environments and develop technologies to mitigate the effects of operational stressors on cognitive function, safety, and mission effectiveness. Develop solutions to enhance human performance and ensure combat effectiveness in AF operations. In FY 2010, this effort merges with major thrust from Project 7757 to better align efforts. In FY 2008: Conducted behavioral research to characterize human performance and mitigate cognitive degradation during demanding military operations. Developed real-time biobehavioral performance monitoring technology to evaluate cognitive readiness and decision making in command and control applications, tactical operations, and mission rehearsal. Explored emerging cognitive disruption technologies and potential countermeasures. In FY 2009: Continue behavioral neuroscience research to characterize and mitigate human cognitive degradation during demanding military operations. Refine real-time biobehavioral performance monitoring technology and develop operational employment concepts. Continue to investigate cognitive disruption technologies and potential countermeasures. In FY 2010: Use performance databases to refine warfighter physical training programs with the goal of improving retention and operational performance. Conduct research integrating behavioral psychology and metabolomic research to enhance human performance in multiple stressor environments.		1.191	1.066	2.733	
MAJOR THRUST: Develop, demonstrate, and apply experimental models for predicting toxicological compromises in human mission performance and create in-house and field methods to assure protection of AF personnel from toxic hazards and exposures in Joint operational environments. Using integrated biological approaches, create predictive algorithms to describe functional cellular dynamics and engineering constructs for advancing detection and performance of AF systems. Improve commander decision-making ability to		1.769	1.941	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
properly balance mission and force protection requirements. Note: In FY 2010, this effort is combined with the next major thrust to better align efforts. In FY 2008: Developed and applied procedures and computer simulation models to predict effects of large volume material, toxic compound, and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and integrated biological approaches to understand functional cellular dynamics and engineering, explored and created integrated new sensor and material constructs for AF applications. In FY 2009: Further develop procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and systems biology approaches to understand functional cellular dynamics and engineering, continue to explore and create integrated new sensor and material constructs for AF applications. In FY 2010: Not Applicable.					
MAJOR THRUST: The applied biotechnology focus area will conduct research using biotechnologies and nanotechnologies to produce advances in warfighter performance. Develop, demonstrate, and apply experimental models and predictive algorithms for enhancing biosensors and interpretation of data from layered sensors. Define toxicological aspects of emerging operational environments. Leverage toxicological/ biological data to create new bio/nanotechnologies and algorithms to improve human performance and decision-making abilities. In FY 2008: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Completed validation panel for selected kidney biomarkers and down-selected liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.		4.072	3.836	4.813	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel. In FY 2010: Conduct research to identify and validate biomarkers relevant to cognitive and physiological changes that enhance human performance. Conduct analysis of novel AF nanomaterial toxicity. Define cell-based pathway engineering for biosensors of human performance.					
MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations. Note: In FY 2009, this effort is terminated due to higher Air Force priorities. In FY 2008: Investigated methods for performance measurement and evaluation of augmented reality, virtual reality, and versatile media formats in packaging and delivering job/task aiding and training solutions for maintenance work. Investigated integration mechanisms for these human-centered technologies with on-board diagnostic/health monitoring technologies to promote more accurate system repair processes at the point of maintenance. In FY 2009: Further explore and apply integrated, multifunction job aiding concepts in laboratory and controlled field tests. Investigate the usefulness of collaboration support for troubleshooting and complex field repair problems. Explore the hardware, software, and packaging issues for combined job aid and on-the-job training devices for maintenance work. In FY 2010: Not Applicable.		1.775	1.332	0.000	
MAJOR THRUST: The counterproliferation area will conduct research to support the detection, identification, neutralization, and assessment of threat agents. Perform counterproliferation research to develop technologies		0.000	0.000	4.915	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
that would provide information for air operations in high threat environments. Note: In FY 2010, this major thrust will move from Project 7757 to better align efforts. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Conduct research to develop nanoparticle taggants for line-of-sight, standoff assessment of preemptive airstrike destruction of biological warfare agents. Define preliminary techniques to effectively neutralize genetically-modified biological threat agents. Perform initial research to anticipate impacts of high threat environments on air operations and to provide post-attack situational awareness.					
CONGRESSIONAL ADD: Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2008: Conducted Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2009: Conduct Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics. In FY 2010: Not Applicable.		1.570	1.995	0.000	
CONGRESSIONAL ADD: Warfighter Pocket XP-Next Gen. In FY 2008: Conducted Congressionally-directed effort for Warfighter Pocket XP-Next Gen. In FY 2009: Not Applicable.		1.569	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Homeland Emergency Learning and Preparedness (HELP) Center. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for HELP Center. In FY 2010: Not Applicable.		0.000	2.992	0.000	
CONGRESSIONAL ADD: Smart View Program (SVP). In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for SVP. In FY 2010: Not Applicable.		0.000	0.798	0.000	
CONGRESSIONAL ADD: Tools and Technologies for Incident and Consequence Management. In FY 2008: Not Applicable. In FY 2009: Conduct Congressionally-directed effort for Tools and Technologies for Incident and Consequence Management. In FY 2010: Not Applicable.		0.000	0.798	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602201F/ Aerospace Flight Dynamics.	0.000	0.000							Continuing	Continuing
PE 0602204F/ Aerospace Sensors.	0.000	0.000							Continuing	Continuing
PE 0602702F/ Command, Control, and Communications.	0.000	0.000							Continuing	Continuing
PE 0603205F/ Flight Vehicle Technology.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603245F/ Flight Vehicle Technology Integration.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

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D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
627757: Directed Energy Bioeffects	28.127	18.938	15.139						Continuing	Continuing

Note

Note: In FY 2010, Performance Evaluation in Extreme Environments efforts will move from Project 7757 to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to electromagnetic energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. This research addresses fundamental physical principles as well as the psychophysical interaction between directed energy and the individual or groups of individuals. Research is divided into three core focus areas: optical radiation bioeffects, radio frequency radiation (RFR) bioeffects, and biobehavioral systems. Optical radiation bioeffects research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. The RFR bioeffects research focuses on theoretical and empirical dosimetry, bioeffects of short- and long-term exposure, methods to counter RFR threats, and exploitation of directed energy systems for offensive capabilities. Biobehavioral systems research concentrates on the design and characterization of scalable directed energy and novel-effects weapons, and their ability to modify human behavior.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The optical radiation bioeffects focus area conducts laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats. In FY 2008: Integrated dynamic bidirectional reflectivity distribution mathematical models into diagnostic tools of laser eye damage for collateral hazard assessments of typical laser systems. Expanded laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluated impact of visible lasers upon critical aircrew and ground force missions. In FY 2009: Perform field and laboratory experiments to verify and validate optical physics model of bidirectional reflectivity distribution calculations for use as high energy laser collateral hazard assessment tool. Integrate collateral hazard assessment software model into airborne laser platform performing high energy	7.414	6.645	7.528	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
laser system demonstrations. Initiate experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects. In FY 2010: Evaluate collateral hazard assessment software model on high energy laser platforms and develop next generation of hazard assessment tools. Further expands laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluate superthreshold tissue impacts and further define weapon effectiveness parameters. Conduct experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.					
MAJOR THRUST: The RFR bioeffects focus area conducts laboratory experiments and field research to enable the safe exploitation of directed energy technologies for communication, target identification, and weapons development while identifying countermeasures to electromagnetic (EM) hazards/threats. In FY 2008: Explored tissue interactions from terahertz frequencies to evaluate safe exposure levels and tissue vulnerabilities. Improved EM tissue models to include terahertz and high power EM effects. Conducted research to support fielding and effectiveness of RFR directed energy weapon systems. In FY 2009: Conduct experiments to refine and eliminate gaps in RFR exposure standards for microwave, ultra-wide band, high peak power RFR systems, and terahertz frequency ranges. Integrate and improve human behavior, bioeffects, and target effects computer models based on RFR studies in microwave, ultra-wide band, high peak power, and terahertz sources. Investigate RFR bioeffects as a foundation for future RFR weapons. In FY 2010: Evaluate biological responses to high power and high peak power EM systems from cellular to whole organism perspectives. Validate models of RFR bioeffects through laboratory and field experimentation, as well as applied mathematics. Conduct research to support fielding and effectiveness of scalable directed energy weapon systems. Conduct research into the bioeffects and safety of terahertz sources.		7.050	6.520	7.216	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: The biobehavioral sciences focus area concentrates on human responses to non-lethal weapons and conducts research to assess the effects and risk of these weapons. Note: In FY 2010, this effort is broken out from the previous major thrust to separate distinct technology areas. In FY 2008: Not Applicable. In FY 2009: Not Applicable. In FY 2010: Develop initial quantitative models of behavioral responses to RFR non-lethal weapons. Develop Human Effect-Modeling Applications Program (HE-MAP) by incorporating a software interface that links graphical user interfaces with predictive models of RFR non-lethal weapon-induced effectiveness and risk. Incorporate within HE-MAP the development of a design optimization and effects-based module that will allow analysis of design parameters and their influence on effectiveness.	0.000	0.000	0.395	
MAJOR THRUST: Develop biotechnologies to accurately and affordably support the detection, identification, neutralization, and assessment of threat agents. Perform counterproliferation research to enable air operations to continue in the most efficient manner. Note: In FY 2010, this major thrust will move to Project 7184 to better align efforts. In FY 2008: Developed and validated methods to assess the viability and activity of threat agents after active countermeasures have been employed. Developed technologies that will enable the AF to locate biological warfare agents behind walls and inside of containers. Characterized organic semiconductor material interactions with directed energy to enhance agent neutralization capabilities. In FY 2009: Refine viability assessment technologies and develop models that predict plume distribution patterns to minimize collateral damage from counterforce weapon detonations. Continue to develop advanced biological taggant technologies that will locate biological warfare agents behind walls and in containers. Investigate counterproliferation technologies capable of effectively neutralizing genetically modified biological threat agents.	6.106	3.731	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER 627757	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY 2010: Not Applicable.					
MAJOR THRUST: Develop novel technology solutions integrating behavioral psychology, metabolomic research, nutritional strategies, and personal protective technologies to enable human performance optimization in multiple stressor environments. Results will optimize operational execution through increased human effectiveness, reduced attrition/lost training days, and faster post-mission recovery. Note: In FY 2010, this major thrust will move to Project 7184 to better align efforts. In FY 2008: Developed methodologies to tailor behavioral and physiological regimens and integrate revolutionary concepts in metabolomics/human performance technologies with existing training/operations. Conducted research to quantify effects of workload distribution, task novelty, and experience on team performance in a cognitively demanding environment. In FY 2009: Continue development and assess benefit of tailored/agile human performance optimization regimens to confront asymmetric threats. Expand biobehavioral performance models to incorporate individual differences in human performance vulnerability. In FY 2010: Not Applicable.		2.064	2.042	0.000	
CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS). In FY 2008: Conducted Congressionally-directed effort for SEOS. In FY 2009: Not Applicable. In FY 2010: Not Applicable.		3.139	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627757

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
CONGRESSIONAL ADD: Ubiquitous RFID Chem/Bio Detection. In FY 2008: Conducted Congressionally-directed effort for Ubiquitous RFID Chem/Bio Detection. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	0.785	0.000	0.000	
CONGRESSIONAL ADD: Modeling of Aggregates of Individuals and Crowd Environments (MAICE). In FY 2008: Conducted Congressionally-directed effort for MAICE. In FY 2009: Not Applicable. In FY 2010: Not Applicable.	1.569	0.000	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER 627757

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0602720A/ Environmental Quality Technology.	0.000	0.000							Continuing	Continuing
PE 0603231F/ Crew Systems and Personnel Protection Technology.	0.000	0.000							Continuing	Continuing
PE 0603456F/ Human Effectiveness Adv Tech Dev.	0.000	0.000							Continuing	Continuing
PE 0604617F/ Agile Combat Support.	0.000	0.000							Continuing	Continuing
PE 0604706F/ Life Support Systems.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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